



United States
Department of
Agriculture

Forest
Service

Arizona Zone
Entomology and
Pathology

2500 S. Pine Knoll Lane
Flagstaff, AZ 86001
FAX: (520) 556-2130
Voice: (520) 556-2073

File Code: 3410

Date: July 22, 1999

Karen Beppler
Resource Management Specialist
Petrified Forest National Park

On the 17th of June, Jill Wilson, Entomologist, and I met with you to discuss the condition of trees at the administrative sites in the park. We spent the majority of time at the visitor center and compound at the north end of the park. The major issues discussed were the importance of shade trees, the varying health of the different species of trees present, and the history of vegetation and irrigation in the park. The following tree species were observed: Russian olive (*Elaeagnus angustifolia*); Siberian elm (*Ulmus pumila*), honeylocust (*Gleditsia triacanthos*), crabapple (*Malus sp.*); piñon (*Pinus sp.*); Fremont cottonwood (*Populus fremontii*); tree-of-heaven (*Ailanthus altissima*); silver poplar (*Populus X alba*), green ash (*Fraxinus pennsylvanica*); New Mexico privet (*Forestiera neomexicana*); juniper (*Juniperus sp.*); and Catalpa (*Catalpa speciosa*). We had also planned to view native and exotic trees along the Puerco River but were "rained out" to a later date. This letter summarizes our discussions and offers suggestions for developing vegetation management plans for the administrative sites.

There were no insects or biological pathogens causing problems in any of the trees observed, but there were plenty of unhealthy trees. Dieback and death of a multitude of species could be attributed to watering regime (or lack-there-of), caliche layers in the soil, and incorrect tree species for the environment.

Like many areas of the Southwest, the soils in the park have layers of caliche. Caliche is a layer where soil particles have been cemented together by carbonates of calcium or magnesium. Caliche can occur as soft thin layers or hard thick beds and there may be more than one layer of caliche in any one location. Caliche affects plants by: **reducing water penetration**, causing inadequate root aeration and salt accumulation in the soil surface; **reducing root penetration**, restricting normal root development and the plant's ability to use soil nutrients and water; and **restricting the plant's ability to use many micronutrients due to high pH**. Iron deficiency is the most common problem associated with this condition.

Russian olive was most prolific in and around parking areas. Although originally planted, it appears to have naturalized in areas which have had irrigation. The plant is adapted to a wide range of soils and moisture conditions, with a special tolerance of drought and salty soils. However, Russian olive can be killed back by extreme drought or winter injury. Some of the Russian olives at the visitor center were showing signs of dieback which could be related to the change in watering that occurred when the irrigation system was turned off. Since Russian olive is known as an invasive species, control measures would be warranted in areas where the tree is not desired. Seedlings and sprouts can be hand-pulled when the soil is moist to insure removal of the root system. On larger plants, cutting alone results in thicker, denser growth. Burning during the dormant season also results in vigorous resprouting. There are herbicides which can



be used to control larger plants. For more information about herbicides you can contact Doug Parker, with our Regional Office staff, at (505)842-3240.

Siberian elm is planted extensively throughout Arizona and New Mexico at elevations below 7,500 feet due to its rapid growth in almost any soil and hardiness to drought and cold. However, it is not doing well at the administrative site as we observed a lot of terminal branch dieback and weakened trees. This tree is generally not recommended for recreational or ornamental plantings because of its tendency towards early mortality or dieback.

Honeylocust in the court yard and trailer area were robust and vigorous trees, providing the best shade and visual beauty on the site. Native to central North America, honeylocust is cultivated extensively throughout Arizona and New Mexico to 7,000 feet. Its vigorous growth in almost any soil and its tolerance of drought make it a valuable tree. There are several varieties and forms of honeylocust, some of them unarmed like the one growing at this administrative site. There are no known serious insect or disease problems of honeylocust, but winter injury or dieback may be common on seedlings grown from poorly adapted seed sources.

The **crabapple** trees growing in the courtyard looked like they had flourished in the past, but are now suffering from lack of supplemental watering.

A few native **juniper** and **piñon** trees were found near the courtyard. These trees are better adapted to the soil and climate conditions in the park, but may make better windbreaks than shade providers.

Some of the **Fremont cottonwood** trees were doing well while others were showing signs of dieback and internal decay. These trees are not recommended in a recreation or urban setting since they are susceptible to injury and decay and can be hazardous.

Tree-of-heaven, **green ash** and **Catalpa** trees are not adapted to the conditions of the site and are all doing very poorly. Although Tree-of-heaven was dying or showing signs of dieback where trees were not being watered, it naturalized as a weed tree where water was available. There was a healthy and vigorous **silver poplar** tree at one of the residences.

One **New Mexico privet** bush was observed. It appeared healthy and was being utilized by birds. New Mexico privet is typically an erect, spreading shrub from 3 to 10 feet tall. The wood is very hard and the branches are sometimes spiny.

We realize the dilemma in the desire for native vegetation but the necessity for shade trees in the high desert environment of Petrified National Park's administrative sites. It is not an easy decision. Some of the existing trees at the visitor center, like the crabapple trees, can be brought back to a healthy state by returning them to a reasonable watering regime and properly pruning the dead and excess branches (see enclosure). Watering trees once every 10 days during the growing season would be sufficient. Deep watering is recommended (see enclosure). Cottonwood, Siberian elm and some of the other species listed above which are not suited to the environment should not be considered for replanting. Some of the existing cottonwood trees which show signs of internal decay and are located near picnic tables and housing areas should be removed due to safety concerns.

We recommend contacting a county extension specialist or the Arboretum at Flagstaff ((520)774-1442) for suggestions on species selection and placement, as well as management of caliche.

Please contact us if you have any more questions.

/s/ Mary Lou Fairweather

Mary Lou Fairweather
Acting Zone Leader
Arizona Zone of Entomology and Pathology

2 Enclosures

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cc:

FOR

D. Parker

J. Wilson

PRUNING STANDARDS

Purpose:

Trees and other woody plants respond in specific and predictable ways to pruning and other maintenance practices. Careful study of these responses has led to pruning practices which best preserve and enhance the beauty, structural integrity, and functional value of trees.

In an effort to promote practices which encourage the preservation of tree structure and health, the W.C. ISA Certification Committee has established the following Standards of Pruning for Certified Arborists. The Standards are presented as working guidelines, recognizing that trees are individually unique in form and structure, and that their pruning needs may not always fit strict rules. The Certified Arborist must take responsibility for special pruning practices that vary greatly from these Standards.

I. Pruning Techniques

- A. A thinning cut removes a branch at its point of attachment or shortens it to a lateral large enough to assume the terminal role. Thinning opens up a tree, reduces weight on heavy limbs, can reduce a tree's height, distributes ensuing invigoration throughout a tree and helps retain the tree's natural shape. Thinning cuts are therefore preferred in tree pruning.

When shortening a branch or leader, the lateral to which it is cut should be at least one-half the diameter of the cut being made. Removal of a branch or leader back to a sufficiently large lateral is often called "drop crotching."

- B. A heading cut removes a branch to a stub, a bud or a lateral branch not large enough to assume the terminal role. Heading cuts should seldom be used because vigorous, weakly attached upright sprouts are forced just below such cuts, and the tree's natural form is altered. In some situations, branch stubs die or produce only weak sprouts.

- C. When removing a live branch, pruning cuts should be made in branch tissue just outside the branch bark ridge and collar, which are trunk tissue. *(Figure 1)* If no collar is visible, the angle of the cut should approximate the angle formed by the branch bark ridge and the trunk. *(Figure 2)*
- D. When removing a dead branch, the final cut should be made outside the collar of live callus tissue. If the collar has grown out along the branch stub, only the dead stub should be removed, the live collar should remain intact, and uninjured. *(Figure 3)*
- E. When reducing the length of a branch or the height of a leader, the final cut should be made just beyond (without violating) the branch bark ridge of the branch being cut to. The cut should approximately bisect the angle formed by the branch bark ridge and an imaginary line perpendicular to the trunk or branch cut. *(Figure 4)*
- F. A goal of structural pruning is to maintain the size of lateral branches to less than three-fourths the diameter of the parent branch or trunk. If the branch is codominant or close to the size of the parent branch, thin the branch's foliage by 15% to 25%, particularly near the terminal. Thin the parent branch less, if at all. This will allow the parent branch to grow at a faster rate, will reduce the weight of the lateral branch, slow its total growth, and develop a stronger branch attachment. If this does not appear appropriate, the branch should be completely removed or shortened to a large lateral. *(Figure 5)*
- G. On large-growing trees, except whorl-branching conifers, branches that are more than one-third the diameter of the trunk should be spaced along the trunk at least 18 inches apart, on center. If this is not possible because of the present size of the tree, such branches should have their foliage thinned 15% to 25%, particularly near their terminals. *(Figure 6)*
- H. Pruning cuts should be clean and smooth with the bark at the edge of the cut firmly attached to the wood.
- I. Large or heavy branches that cannot be thrown clear, should be lowered on ropes to prevent injury to the tree or other property.
- J. Wound dressings and tree paints have not been shown to be effective in preventing or reducing decay. They are therefore not recommended for routine use when pruning.

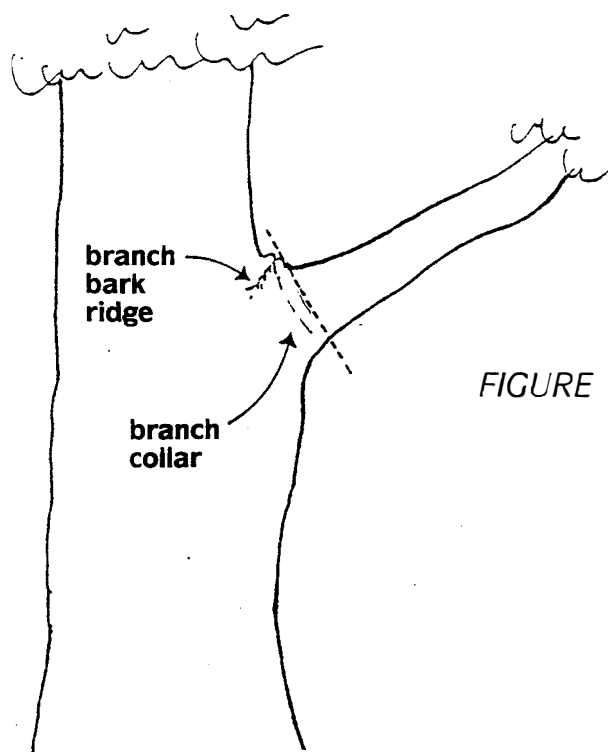


FIGURE 1. When removing a branch, the final cut should be just outside the branch bark ridge and collar.

FIGURE 2. In removing a limb without a branch collar, the angle of the final cut to the branch bark ridge should approximate the angle the branch bark ridge forms with the limb. Angle AB should equal Angle BC.

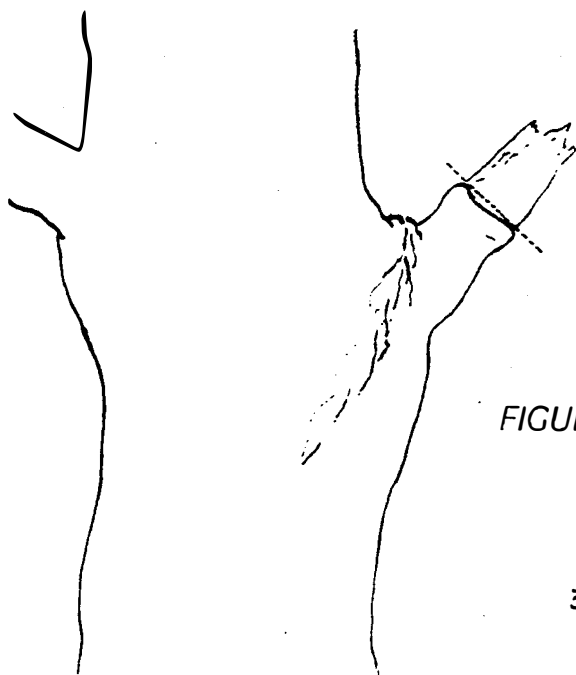
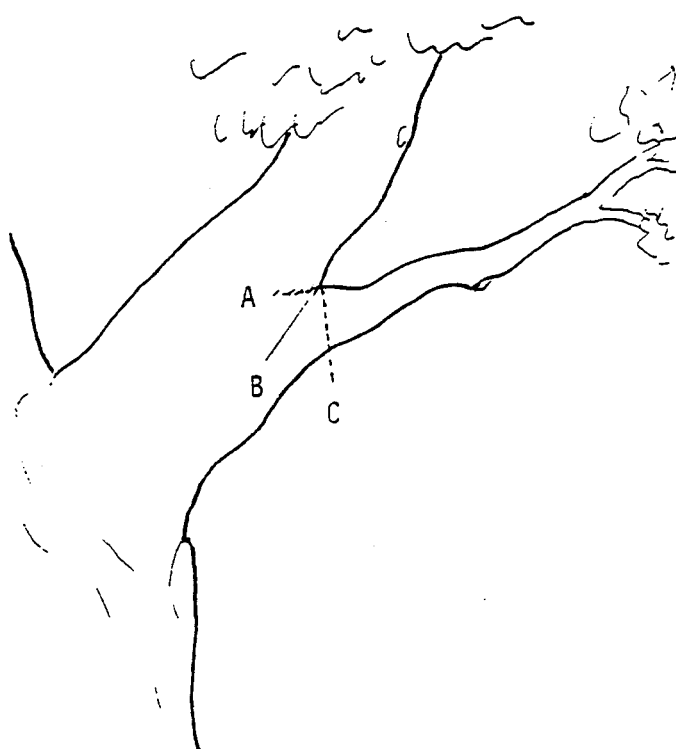


FIGURE 3. When removing a dead branch, cut outside the callus tissue that has begun to form around the branch.

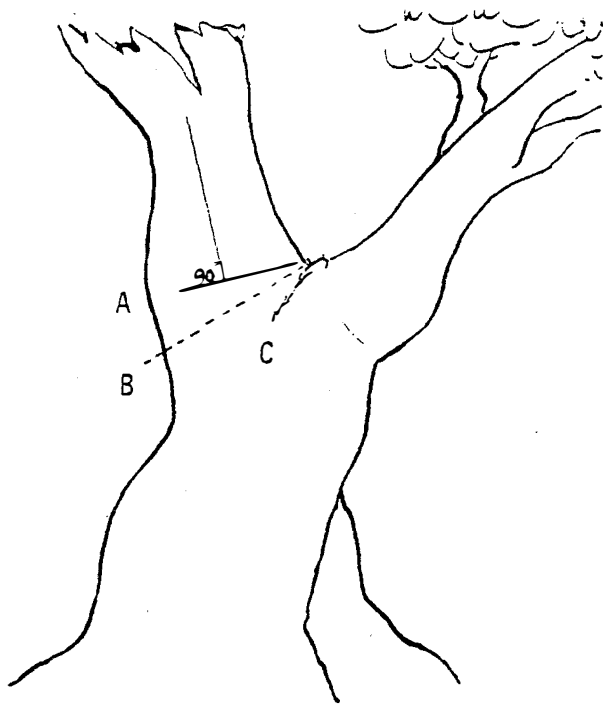
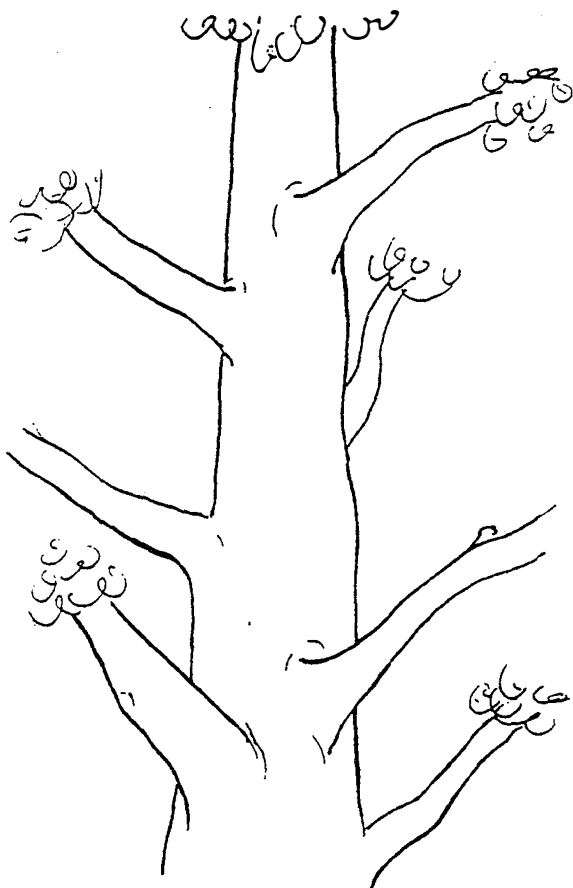


FIGURE 4. In removing the end of a limb to a large lateral branch, the final cut is made along a line that bisects the angle between the branch bark ridge and a line perpendicular to the limb being removed. Angle AB is equal to Angle BC.

FIGURE 5. A tree with limbs tending to be equal-sized, or codominant. Limbs marked B are greater than $\frac{3}{4}$ the size of the parent limb A. Thin the foliage of branch B more than branch A to slow its growth and develop a stronger branch attachment.



FIGURE 6. Major branches should be well spaced both along and around the stem.



II. Types of Pruning — Mature Trees

A. CROWN CLEANING

Crown cleaning or cleaning out is the removal of dead, dying, diseased, crowded, weakly attached, and low-vigor branches and watersprouts from a tree crown.

B. CROWN THINNING

Crown thinning includes crown cleaning and the selective removal of branches to increase light penetration and air movement into the crown. Increased light and air stimulates and maintains interior foliage, which in turn improves branch taper and strength. Thinning reduces the wind-sail effect of the crown and the weight of heavy limbs. Thinning the crown can emphasize the structural beauty of trunk and branches as well as improve the growth of plants beneath the tree by increasing light penetration. When thinning the crown of mature trees, seldom should more than one-third of the live foliage be removed.

At least one-half of the foliage should be on branches that arise in the lower two-thirds of the trees. Likewise, when thinning laterals from a limb, an effort should be made to retain inner lateral branches and leave the same distribution of foliage along the branch. Trees and branches so pruned will have stress more evenly distributed throughout the tree or along a branch.

An effect known as “lion’s-tailing” results from pruning out the inside lateral branches. Lion’s-tailing, by removing all the inner foliage, displaces the weight to the ends of the branches and may result in sunburned branches, watersprouts, weakened branch structure and limb breakage.

C. CROWN REDUCTION

Crown reduction is used to reduce the height and/or spread of a tree. Thinning cuts are most effective in maintaining the structural integrity and natural form of a tree and in delaying the time when it will need to be pruned again. The lateral to which a branch or trunk is cut should be at least one-half the diameter of the cut being made.

D. CROWN RESTORATION

Crown restoration can improve the structure and appearance of trees that have been topped or severely pruned using heading cuts. One to three sprouts on main branch stubs should be selected to reform a more natural appearing crown. Selected vigorous sprouts may need to be thinned to a lateral, or even headed, to control length growth in order to ensure adequate attachment for the size of the sprout. Restoration may require several prunings over a number of years.

II. Types of Pruning — Mature Trees (*continued*)

E. CROWN RAISING

Crown raising removes the lower branches of a tree in order to provide clearance for buildings, vehicles, pedestrians, and vistas. It is important that a tree have at least one-half of its foliage on branches that originate in the lower two-thirds of its trunk to ensure a well-formed, tapered structure and to uniformly distribute stress within a tree.

When pruning for view, it is preferable to develop “windows” through the foliage of the tree, rather than to severely raise or reduce the crown.

III. Size of Pruning Cuts

Each of the Pruning Techniques (Section I) and Types of Pruning (Section II) can be done to different levels of detail or refinement. The removal of many small branches rather than a few large branches will require more time, but will produce a less-pruned appearance, will force fewer watersprouts and will help to maintain the vitality and structure of the tree. Designating the maximum size (base diameter) that any occasional undesirable branch may be left within the tree crown, such as ½", 1" or 2" branch diameter, will establish the degree of pruning desired.

IV. Climbing Techniques

- A. Climbing and pruning practices should not injure the tree except for the pruning cuts.
- B. Climbing spurs or gaffs should not be used when pruning a tree, unless the branches are more than throw-line distance apart. In such cases, the spurs should be removed once the climber is tied in.
- C. Spurs may be used to reach an injured climber and when removing a tree.
- D. Rope injury to thin barked trees from loading out heavy limbs should be avoided by installing a block in the tree to carry the load. This technique may also be used to reduce injury to a crotch from the climber's line.

sure differences in the leaf temperatures of exposed and unexposed leaves at some distance from a plant if they are pointed at the surface in question. This method of measuring a plant's moisture level is in a developmental stage but potentially offers a substantial new tool for managing plant water regimes. It can also be used to detect plant stress from other causes when soil moisture is adequate.

ESTIMATING HOW MUCH WATER IS APPLIED

The amounts of water in the soil that evapotranspire or are applied as rainfall or irrigation are most easily expressed as the equivalent to the depth (in millimeters or inches) of an equal amount of water on the surface of the ground. That measure is useful even when the area involved is not known. The depth of rainfall and sprinkler application is measured easily. The amount applied by other means must be measured by volume (in liters or gallons), though some irrigation distribution systems have a meter to record the amount of water applied. You can estimate the rate of water application by measuring how long it takes to fill a large container of known volume (about 50 liters or 10 gal) when the rate of application is similar to the irrigation rate. For a drip system, catch the flow of each of several emitters in a calibrated cylinder for 1 minute. The rate of discharge will vary with changes in water pressure and in the length and diameter of the distribution line beyond the point of measurement. The amount of water applied can be determined by the time and rate of discharge. The amount of water needed can be calculated by multiplying the area to be irrigated by the depth of water wanted. Table 12-2 records the effects of soil texture, soil depth, and ET on available water, irrigation intervals, and time required to replenish the water.

MANAGING WATER APPLICATION

In most situations, enough water should be applied at each irrigation to replace water that is used. If enough water is applied to penetrate deeply and to be absorbed before subsequent irrigations, deep rooting will be encouraged and crown-rotting organisms minimized. If the soil is allowed to dry between irrigations, it will shrink and swell maximally, a process of internal cultivation that improves soil structure. Shallow rooting is usually caused by irrigating so lightly that only

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surface soil is wetted or by irrigating so heavily that soil is waterlogged and only the surface soil has adequate aeration. Shallow-rooted plants are more likely to be blown over by wind and are more subject to water stress than deeply-rooted plants.

If the correct amount of water is evenly distributed over a uniform, deep soil, it should produce the best plant growth for the least amount of water. But uniform distribution also requires that the water infiltrate near the site of application. The way in which water is applied greatly affects its distribution; soil topography and the rate of application greatly affect infiltration. When water is applied faster than it can infiltrate, soil topography becomes important. Reshaping the soil surface or creating small catch basins will sometimes allow water to enter the soil more uniformly. See Chapter 7 on Irrigation Systems.

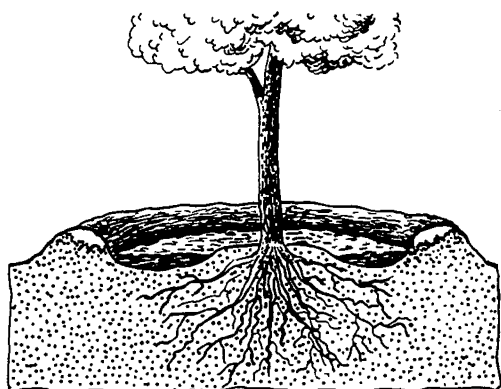
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Water can be applied in basins by fixed bubblers (small sprinkler-like heads that spray or dribble water onto the soil), hoses, sprinklers, nozzles, or tank trucks (Fig. 12-5). Even in nearly level basins, too much water will be applied near the water inlets if the rate of application is too slow or the number of outlets too few for the texture of the soil and the size of the basin. This can be corrected by creating smaller basins, adding more water outlets around the basin, or increasing the rate of water flow. Basin irrigation may wash lightweight mulch to low areas or away from water inlets. A gravel or rock mulch, at least around the water inlets, will reduce this problem if the flow of water itself cannot be sufficiently reduced.

FIGURE 12-5

Basin irrigation can be used in areas that are relatively level and will be used little for recreation or thoroughfare.



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